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Estimates of Cetacean and Pinniped Bycatch in the 2009 New England Sink Gillnet and Mid-Atlantic Gillnet Fisheries

by Christopher D. Orphanides

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ABSTRACT

This report provides incidental take estimates for five marine mammal species observed taken in the 2009 New England sink gillnet (NESG) and Mid-Atlantic gillnet (MAG) fisheries and documents the methodology used to produce the estimates. The estimated incidental takes in the 2009 NSEG fishery were 43 (CV = 77%) common dolphins (*Delphinis delphis*), 591 (CV = 23%) harbor porpoises (*Phocoena phocoena*), 1063 (CV = 26%) gray seals (*Halichoerus grypus*), 516 (CV = 28%) harbor seals (*Phoca vitulina*), and 415 (CV = 27%) harp seals (*Phoca groenlandica*). For the MAG fishery, the estimated 2009 incidental takes were 201 (CV = 55%) harbor porpoises, 70 (CV = 69%) harp seals, and 47 (CV = 68%) harbor seals.

INTRODUCTION

Section 117 of the Marine Mammal Protection Act (MMPA) states that estimates of annual human-caused mortality and serious injury to marine mammal stocks must be reported in annual stock assessment reports (SAR) for each stock of marine mammal that occurs in waters under U.S jurisdiction. In part to respond to this mandate, the Northeast Fisheries Science Center (NEFSC) Northeast Fisheries Observer Program (NEFOP) was initiated in 1989 to document the bycatch of marine mammals taken incidentally in commercial fishing operations (Waring et al. 2004). Since the initiation of the observer program, the estimation of total incidental takes for harbor porpoise (*Phocoena phocoena*) has been the focus of much attention due to frequent observations of incidental takes occurring in the New England sink gillnet (NESG) fishery[1] (NMFS 1998). This attention led to the development of a stratification method designed to estimate the total annual incidental takes of harbor porpoise (Bisack 1993; Smith et al. 1993; Bravington and Bisack 1996; Bisack 1997; Rossman and Merrick 1999; Bisack 2003). The regional scope of the NEFOP was expanded into the Mid-Atlantic (MA) region in 1995 to learn more about marine mammal interactions occurring in MA gillnet fisheries.

Rossman and Merrick (1999) documented the methods used to estimate harbor porpoise bycatch in the NESG and Mid-Atlantic gillnet (MAG) fisheries. These methods were subsequently used to estimate the bycatch of other marine mammal species incidentally caught in the NESG and MAG fisheries (Blaylock et al. 1995; Waring et al. 1997; Waring et al. 2004; Belden et al. 2006; Belden 2007; Belden and Orphanides 2007; Orphanides 2010).

The NESG fishery extends from Maine to Connecticut and is dominated by bottom-tending sink gillnets. Less than 1% of the fishery utilize a drift gillnet (not anchored and not tending toward the ocean bottom). Monofilament twine is typically used with stretched mesh sizes ranging from 6-12 in (Waring et al. 2004). According to data collected by the NEFOP from 1999 through 2009, string lengths ranged from 150 to over 10,000 ft, though most were about 3,000 ft. Mesh size and string lengths varies by the primary fish species targeted for catch (Waring et al. 2004).

The MAG fishery generally ranges from Connecticut to North Carolina and utilizes both drift and sink gillnets. These nets are most frequently attached to the bottom, although unanchored drift or sink nets are also utilized to target specific species. Monofilament twine is again the dominant material and is used with stretched mesh sizes typically ranging from 2.5-12

[1] The New England sink gillnet fishery (NESG) was called the Northeast sink gillnet fishery in previous cetacean and pinniped gillnet bycatch estimating documents (e.g., Orphanides 2010). This name change was made to be consistent with recent Harbor Porpoise Take Reduction Plan (HPTRP) documents (e.g., NOAA 2010) and to avoid confusion with the HPTRP Northeast Management Area. This change is in name only; the fishery being specified and its extent have not changed from previous cetacean and pinniped gillnet bycatch estimating documents.

in (Waring et al. 2004). According to data collected by the NEFOP from 1999 through 2009, string lengths ranged from 100 to over 10,000 ft, though typically were between 1,000 and 1,500 ft. The mesh sizes and string lengths vary by the primary fish species targeted for catch (Waring et al. 2004).

After the 2005 bycatch estimates, the division between the New England and Mid-Atlantic changed from a system based on vessel home port (divided at the Connecticut-Rhode Island border) to one based on reported fishing location. For the 2006-2009 bycatch estimates, the NESG and MAG fisheries were defined by a division at 72º30'W longitude, extending south to the NC/SC border.

The present analysis of the 2009 data uses the same general ratio estimator methodology that was used to calculate cetacean and seal bycatch for the 2006-2008 NESG and MAG fisheries (Belden and Orphanides 2007, Orphanides 2010). However, there have been a few minor changes in the stratification. These changes and the resulting bycatch estimates are described in this report.

METHODS

Data Sources

Five databases were used to estimate the total marine mammal incidental takes in 2009: NEFOP, Allocated Commercial Landings, Northeast Vessel Trip Reports (VTR), North Carolina Division of Marine Fisheries (NCDMF) Trip Ticket Program, and NMFS gillnet hanging ratios study databases. The NEFOP data were used to estimate the bycatch rate of marine mammals caught in the 2009 New England and Mid-Atlantic gillnet fisheries. The NEFOP has two types of sampling protocols when observing gillnet fishing trips: (1) complete fish sampled trips where the observer samples the catch for fish discard information, thus the observer is not able to watch the net as it is being hauled in and so might miss an incidental take; and (2) limited fish sampled trips where the observer watches the net for incidental takes as it is being hauled in and thus should not miss any incidental takes.

In the NESG and MAG fishery, hauls observed from both trip sampling protocols were used to estimate the 2009 bycatch rates for all species, as had been done for the 2006 MAG common dolphin bycatch estimates (Belden and Orphanides 2007), all species in the 2007-2008 MAG estimates (Orphanides 2010), and for all species in the 2004-2008 NESG fisheries (Belden et al. 2006; Belden 2007; Belden and Orphanides 2007; Orphanides 2010). Prior to the 2006 MAG estimates, only limited fish sampling trips in the MAG fishery were used to estimate the bycatch rates of most marine mammal species. However, because of increased bycatch observed on complete trips, the 2007 - 2008 (Orphanides 2010), and 2009 Mid-Atlantic estimates (see results section for details) were calculated using both complete and limited trips. Using data from both types of sampling protocols avoids discarding many observed incidental takes and so increases the sample size which provides more robust estimates.

The Allocated Commercial Landings and Northeast Vessel Trip Reports (VTR) were used to calculate the total landings of all finfish caught north of North Carolina in the 2007 – 2008 (Orphanides 2010), and 2009 New England and Mid-Atlantic gillnet fisheries. Though this approach differs from years prior to 2007, it provides a more accurate calculation by greatly limiting the amount of proration applied to the commercial landings data. Prior to the use of the Allocated Commercial Landings data, no Commercial Landings data were directly matched to VTR trips. So, the VTR data (which contains fishing locations) were used to prorate all Commercial Landings data to the proper spatial-temporal strata (e.g., Belden and Orphanides

2007). Now, using Allocated Commercial Landings data, much of this proration is unnecessary since many of the VTR trips are directly linked to the Allocated Commercial Landings data. This approach also provides a more accurate split between the New England and Mid-Atlantic fisheries because in most instances the VTR locations are linked directly with the commercial landings data.

The Allocated Commercial Landings data merges the VTR logbook and Northeast Dealer Report data by trip, wherever possible (70% of VTR gillnet trips in 2009 were matched to Northeast Dealer Report data). Thus the gear characteristic information of the VTR logbooks is linked with the near census of landings in the Dealer Report data (Wigley et al. 2008).

In the cases where VTR and Allocated trips were successfully matched one to one, the Allocated landings, locations, and other characteristics for these trips were used in this analysis. In the cases where the VTR and Allocated trips could not be matched one to one, a proration scheme was used which was based on strata defined by state, season, and year, as was done in previous years (e.g., Belden and Orphanides 2007). That is, for strata where the total Allocated landings were greater than total VTR landings, the landings of each VTR trip in those strata were multiplied by a raising factor that ensured the total VTR landings for those strata equaled the total Allocated landings for those same strata. Thus, it was assumed that the available VTR trips were spatially and temporally representative of the trips that did not provide VTR logbooks or under-reported landings in their VTR logbooks. In the cases where the VTR landings in a particular stratum were larger than landings in the corresponding stratum in the Allocated data (11% of all VTR trips in 2009, and 36% of unmatched VTR trips had more landings than in the corresponding Allocated data), the Allocated landings were retained unless no Allocated landings were present for those strata, in which case the VTR landings were used. This approach respects the assumption that the commercial Northeast Dealer Report landings data represents a near census of all landings in the fishery, while still allowing for a limited amount of flexibility that ensures that the spatial and temporal distribution of landings is representative of effort in the VTR. The resulting landings combining the VTR and Allocated data will be referred to as the prorated metric tons of landings.

For North Carolina fishing effort, the VTR and Allocated landings data were considered incomplete so NCDMF data were used to estimate total landings from North Carolina gillnet trips. The NCDMF data are considered a census of the total amount of landings in North Carolina. The monthly gillnet landings from North Carolina were combined with the VTR-Allocated effort data from areas north of North Carolina.

From February through April of 2009, NMFS conducted a study to examine the effects of gillnet hanging ratios on harbor porpoise bycatch. The observed landings from these gillnet hauls were subtracted from the Winter South of Cape Cod port-group area stratum prorated metric tons of landings, and put in their own gillnet hanging ratio study strata (Table 1). The observed hauls, trips, and landings from the hanging ratio study were considered observed effort and used in the calculation of New England observer coverage. The number of cetaceans and pinnipeds incidentally caught as part of the study were added directly to bycatch estimate totals and were not used in calculating bycatch rates.

Analysis

An “incidental take” is defined as any observed incidentally caught marine mammal that was recorded as either alive with injuries or dead (fresh or under various stages of decomposition). In 2009, no incidental takes were recorded as alive. Incidental takes not

identified to species were not included in the bycatch estimates. This included 8 unknown seals in 2009.

The level of sampling (observer coverage) within each stratum was calculated by dividing the observed metric tons (mtons) of landings by the prorated metric tons of landing recorded in the effort datasets. This value represented the fraction of total landings that were sampled.

Data Stratification

The strata as defined in Rossman and Merrick (1999) were used to estimate NESG fishery incidental takes, as has been done since 1999. That is, the NESG fishery data were stratified temporally by season, spatially by port group-area and time/area closures (Figure 1, Table 1), and also by the presence/absence of pingers. Seasons were defined as winter (January to May), summer (June to August), and fall (September to December). The temporal/spatial/pinger strata were based on the harbor porpoise take reduction plan that was in effect during 2009 (NMFS 1998) and the migration patterns of the harbor porpoise. One additional winter stratum was used for 2009 that was the NMFS gillnet hanging ratio study, which occurred from February through April south of Cape Cod (Table 1).

Prior to 2006, the MAG and NESG fisheries were defined for the purposes of these bycatch estimates by port landed, where Connecticut (CT) and states south and west were included in the MAG fishery, and Rhode Island (RI) and states north and east were included in the NESG fishery. For the 2006 - 2009 bycatch analyses, the division of the NESG and MAG fisheries was determined by the recorded locations of the gillnet gear. For the 2006-2009 bycatch estimates, the 72º30'W longitude line (Figure 1) was used to divide the two fisheries (Belden and Orphanides 2007, Orphanides 2010). As a result, trips landing in CT, NY, and NJ which fished east of 72º30'W were included in the NESG fishery and were within the South of Cape Cod port group, while data from trips which fished west of this line were included in the MAG fishery (Tables 1 - 2). The MAG bycatch estimates for 2009 harbor seals (*Phoca vitulina*) and harp seals (*Pagophilus groenlandicus*) were calculated using strata defined by fishing region and season, where the season was January-April, and the fishing region was Waters off New Jersey (Figure 1). This fishing region-season stratification is slightly different than previous years (e.g., 2005-2008) when MAG bycatch estimates were calculated using a state-season stratification ((Belden 2007; Belden and Orphanides 2007; Orphanides 2010) based on the state where a vessel's catch was landed. Using a fishing region-season stratification improves spatial cohesion by ensuring that fishing effort occurring in the same area is treated as one unit no matter where vessels land their catch. In practice, this spatial stratification differs only a small degree from the state-season stratification since the majority of observed vessels that fished in the January to April fishing season in the Waters off New Jersey in 2009 also landed their catch in New Jersey (87% of landings and 90% of hauls).

The 2009 Waters off New Jersey harbor porpoise bycatch estimate approach used the same fishing region-season stratification as was done with Mid-Atlantic harp and harbor seal incidental takes, but included additional mesh size stratification. The same mesh size categories were used in the 2009 Waters off New Jersey estimate as were used for the 2008 MAG estimates (< 6.535", 6.535-9.150", and > 9.150") (Orphanides 2010). Including mesh size in the Mid-Atlantic harbor porpoise stratification was suggested by Orphanides (2009) in a thorough examination of the most appropriate means to estimate harbor porpoise bycatch in the northwestern Atlantic U.S. gillnet fisheries. Harbor porpoise bycatch rates were shown to be

different in nets with different mesh sizes (Orphanides 2009; Palka et al. 2008a), as has also been shown for other marine mammals (Palka and Rossman 2001) and sea turtles (Murray 2009).

For bycatch estimates of harbor porpoise in North Carolina waters, a state-season stratification was used. Due to the limitations of VTR and NCMDF data in North Carolina, mesh size could not be incorporated into the estimate as reliable mesh size estimates were not available for the North Carolina fishery. State effort was used for the spatial stratification, instead of more explicitly defining an area based on latitude because the NCDMF data do not provide latitude and longitude for fishing effort and the VTR data from North Carolina are considered incomplete. The season used for the North Carolina harbor porpoise strata was February and March since these months are the only months in the NEFOP time series (1989-2009) when harbor porpoise have been observed incidentally taken in North Carolina waters.

Bycatch Rates

The estimated number of marine mammal incidental takes (B) is the sum of the estimated number of incidental takes within each stratum (i) where there are a total of S strata:

$$B = \sum_{i=1}^{S} \frac{number\ \ observed\ \ takes_i}{observed\ \ effort_i} \bullet total\ \ effort_i$$

The estimated number of incidental takes within a stratum is the product of the observed bycatch rate within that stratum multiplied by the total effort within that stratum. The observed bycatch rate within a stratum is defined as the number of incidental takes observed within a stratum divided by the observed mtons of landings (effort) in that stratum.

Some gillnets in the NESG fishery are equipped with pingers, and the bycatch rate of nets with pingers differs from the rate of nets without pingers (Palka et al. 2008b). To accommodate this difference, a weighted bycatch rate (WBR) was calculated for strata that have both hauls with and without pingers. Within a stratum, two weighted bycatch rates were first calculated, one from hauls with pingers (WBRp) and one from hauls without pingers (WBRnp):

$$WBRp = \left(observed\ \ takes_{with.\ pingers} \Big/ observed\ \ effort_{with.\ pingers} \right) * observed\ \ hauls_{with.\ pingers}$$

$$WBRnp = \left(observed\ \ takes_{no.\ pingers} \Big/ observed\ effort_{no.\ pingers} \right) * observed\ hauls_{no.\ pingers}$$

Next, within a stratum, a total weighted bycatch rate (WBR) was calculated that incorporates hauls both with and without pingers:

$$WBR = \frac{WBRp + WBRnp}{total\ \ hauls}$$

Standard bootstrapping techniques were used to derive the confidence intervals and coefficients of variation (CV) for the bycatch estimates for each stratum. The re-sampling unit used was an entire trip rather than an individual haul to ensure that any within trip dependence was carried over into the estimated CV (Bisack 2003).

RESULTS

New England Sink Gillnet Fishery

The overall annual observer coverage in the NESG was 3.8%, ranging from 1.8% in the summer to 7.8% in the winter (Table 1). This level is lower than the coverage level in 2008, which was 4.6%, ranging from 3.9% in the summer to 6.1% in the winter (Orphanides 2010). Three common dolphins (*Delphinus delphis*), 45 harbor porpoises, 52 gray seals (*Halichoerus grypus*), 21 harbor seals, 32 harp seals, and 8 unknown seals were observed incidentally taken in the 2009 NESG fishery. Among the animals observed incidentally taken in the NESG fishery, 12 harbor porpoise, 9 harp seals, 6 gray seals, and 1 common dolphin were incidentally caught during an experimental study to examine the impact of gillnet hanging ratio on harbor porpoise bycatch. These animals were included in the total bycatch estimate, but were not used to calculate bycatch rates. Unidentified animals were not included in the bycatch estimates.

The 2009 NESG estimated total incidental takes of cetaceans included 43 (CV = 77%) common dolphins (Table 3) and 591 (CV = 23%) harbor porpoises (Table 4). The 2009 estimated total incidental takes of pinnipeds in the NESG fishery included 1063 (CV = 26%) gray seals (Table 5), 516 (CV = 28%) harbor seals (Table 6), and 415 (CV = 27%) harp seals (Table 7).

Mid-Atlantic Gillnet Fishery

The 2009 observer coverage for the MAG fishery using both complete fish sampling trips (i.e., complete trips) and limited fish sampling trips (i.e., limited trips) was 2.9% (Figure 2; Table 2). The 2009 observer coverage for Waters off New Jersey from January through April was 4.3% for all mesh sizes (harbor and harp seal strata), and was 4.4% for large mesh effort in the same time and area (harbor porpoise strata) (Table 8). The 2009 observer coverage for Feb-Mar off of North Carolina was 1.5% (Table 8). There were 7 harbor porpoise, 2 harbor seal, and 3 harp seal observed incidentally taken in the MAG fishery in 2009 (Table 9). All MAG observed incidentally taken animals except one harbor porpoise were taken in the Waters off New Jersey. Within the MAG, six out of seven harbor porpoise, one out of two harbor seals, and all three harp seals were caught on complete hauls. The observed large mesh hauls for the 2009 winter Waters off New Jersey harbor porpoise time-area strata included 25 complete hauls, and 36 limited hauls. The 2009 Mid-Atlantic harp and harbor seal time-area strata for all mesh sizes included 26 complete hauls and 71 limited hauls. No limited hauls in this stratum were on a vessel from a New England home port, and 20 out of the 26 complete hauls were from vessels with a New England home port. Also, five out of the seven hauls with marine mammal bycatch in this stratum were from New England home ports (though their catch may have been landed in the Mid-Atlantic). The 2009 North Carolina harbor porpoise time-area strata included 3 complete hauls and 106 limited hauls (Table 8).

The 2009 estimated total incidental takes for cetaceans in the MAG fishery included 201 (CV = 55%) harbor porpoises (Table 9). The 2009 estimated total incidental takes for pinnipeds

in the MASG fishery was 47 (CV = 68%) harbor seals (Table 9) and 70 (CV = 69%) harp seals (Table 9).

DISCUSSION

The calculation of the 2009 cetacean and pinniped gillnet bycatch estimates involved few changes from the 2008 estimate approaches and largely used the same structure. Two minor changes involved modifying the Mid-Atlantic bycatch stratifications. The 2009 Mid-Atlantic estimates used a fishing area, instead of the state landed as was done in past years, to define the spatial area used for bycatch estimation in the Waters off New Jersey. This change results in improved spatial stratification as the spatial stratum is more representative of the effort in the area where incidental takes occurred. In past years, a vessel could have fished in the time and area where a bycatch event occurred but not have been included in the bycatch estimate because their catch was landed outside of New Jersey. Though the stratification is theoretically improved, the actual difference is limited since only 13% of landings in the Waters off New Jersey were landed outside of New Jersey.

The other difference for the 2009 estimates occurred when estimating harbor porpoise bycatch off of North Carolina. Observed harbor porpoise incidental takes in this area are rare. Previously, a stratum of state and month was used because of uncertainty regarding when harbor porpoise are in the area off of North Carolina. But now, given that there is a 21 year time series (1989-2009) of NEFOP incidental take data available, a winter season of February and March was used since these were the only months that harbor porpoise bycatch (seven animals from 1989-2009) has been observed in gillnets off of North Carolina. Unfortunately, because of data quality problems in the North Carolina VTR, and limited data fields available in the NCDMF data, mesh size could not be incorporated into the bycatch estimates off North Carolina. Similarly, the North Carolina spatial stratification was limited to catch landed in North Carolina, instead of a fishing area off of North Carolina, because of uncertainty in the actual fishing locations of trips reported in the NCDMF data.

Lastly, Orphanides (2010) suggested examining the impact of complete and limited NEFOP trip types on observed incidental takes. The increase of observed incidental takes on complete trips (as compared to limited trips) in the Waters off of New Jersey (Orphanides 2010) is counterintuitive. Theoretically, if there were to be a bias in complete and limited trips, one would expect more bycatch to be observed on limited trips. On a “complete” trip the observer is not dedicated to watching for incidental protected species takes. Thus, there is a possibility that more incidental takes on “complete” trips may go unobserved than on “limited” trips where the observer is specifically tasked with watching the net for incidental takes.

However, over the last few years there has been a shift in the allocation of limited and complete trips which could help explain the higher bycatch rates seen recently on complete trips. Over the last several years funding available for limited trips has decreased while funding for complete trips has increased due to concerns over fish discards. Therefore, the NEFSC Protected Species Branch (PSB) has shifted coverage for more limited fishing trips to the Mid-Atlantic, where there is typically less coverage, while relying increasingly on complete trips in New England to document marine mammal bycatch. This shift results in fewer limited days to cover New England trips in general, but also results in limited trips being concentrated in fewer ports. Some smaller ports are left with no limited trips, or only one day in a month, which is not always enough to cover a trip from New England to the Waters off New Jersey. The result of this trend

was that in 2009 the only trips originating from New England home ports that fished in Waters off New Jersey from January through April were complete trips.

Compounding this shift in limited days away from New England ports, the majority of gillnet marine mammal incidental takes in the Waters off New Jersey occur on vessels from New England home ports (though their catch is often landed in New Jersey). A post-hoc analysis of NEFOP data showed that, from 1989 through 2009, 75% (123/163) of harbor porpoise, harbor seal, gray seal, and harp seal incidental takes in the Waters off New Jersey occurred on vessels from New England home ports (Connecticut, Rhode Island, Massachusetts, New Hampshire, and Maine). This is despite New England home port vessels accounting for only 28% (341/1198) of observed hauls during this time and area. This corresponds well with 2009 data where 83% (10/12) of observed incidental takes were from New England home ports while only 21% (20/97) of hauls were from New England based vessels.

The higher bycatch rates seen on hauls from New England home ports in the Waters off New Jersey from January through April could be linked, at least in part, to the large mesh sizes (12 in) typically used by vessels fishing in this time and area from New England home ports. Harbor porpoise (Orphanides 2009), coastal bottlenose dolphin (Palka and Rossman 2001), and sea turtle (Murray 2009) bycatch rates have been shown to increase with increasing mesh size. Since 2000, all observed hauls on New England based vessels in this time and area fished with 12 in mesh, as compared to 57% of non-New England vessels during the same time and area. Including mesh size in the Waters off New Jersey stratification for harbor porpoise ensures that the bycatch rate calculation is not biased by ignoring the influence of New England based vessels with higher bycatch rates. It is not known whether pinniped bycatch rates increase with increasing mesh size, though adding mesh size stratification to the calculation of pinniped bycatch estimates in this time and area should be explored to avoid bias in future bycatch estimates. In summary, the higher likelihood of an incidental take occurring on a New England based vessel, the consistent use of large mesh sizes on hauls from New England based vessels, and the gradual shift towards more complete trips out of New England, are likely the primary reasons behind the increased observed bycatch on complete trips in this region.

Additional research into the complete and limited trip type issue should continue and expand to investigate areas outside of the Waters off New Jersey. This research should explore additional parameters such as observer and vessel effects. In addition, incidental takes of all cetacean and pinniped species in gillnets, instead of just harbor porpoise, should be included in the analysis to boost sample sizes and the robustness of any results that follow.

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Table 1. Using both limited and complete observed trips, 2009 New England sink gillnet totals for observed trips, observed hauls, limited hauls, observed metric tons of fish landed, prorated total metric tons of fish landed, and percent observer coverage, by season and port group or closure strata.

2009 Winter (Jan-May)	Observed Trips	Observed Hauls (Limited Hauls)	Observed Metric Tons	Prorated Metric Tons	Coverage (Metric Tons) %
Port Group-Area Strata					
Northern Maine	0	0 (0)	0.00	0.40	0.00
Southern Maine	1	5 (5)	1.25	44.06	2.84
New Hampshire	0	0 (0)	0.00	0.00	0.00
North of Boston	89	293 (90)	33.63	312.59	10.76
South of Boston	16	50 (18)	4.33	131.93	3.28
South of Cape Cod	20	81 (53)	45.21	1332.05	3.29
East of Cape Cod	22	107 (25)	51.04	685.54	7.45
Offshore	1	13 (0)	11.60	98.14	11.82
Closure Strata					
Offshore Closure	10	129 (8)	50.04	213.57	23.43
Cashes Ledge Closure	0	0 (0)	0.00	12.53	0.00
Midcoast Closure	22	81 (35)	14.80	216.91	6.82
Mass Bay Closure	30	108 (37)	12.81	174.09	7.36
Cape Cod Bay Closure	0	0 (0)	0.00	2.00	0.00
South Cape Closure	21	88 (23)	36.83	634.18	5.81
Great S. Channel Closure	0	0 (0)	0.00	0.45	0.00
Hanging Ratio Study					
South of Cape Cod Study	21	79 (79)	43.28	43.28	1.00
Subtotal	253	1034 (373)	304.82	3901.72	7.81

Table 1, continued. Using both limited and complete observed trips, 2009 New England sink gillnet totals for observed trips, observed hauls, limited hauls, observed metric tons of fish landed, prorated total metric tons of fish landed, and percent observer coverage, by season and port group or closure strata.

Summer (Jun-Aug)	Observed Trips	Observed Hauls (Limited Hauls)	Observed Metric Tons	Prorated Metric Tons	Coverage (Metric Tons) %
Port Group-Area Strata					
Northern Maine	0	0 (0)	0.00	103.27	0.00
Southern Maine	2	5 (0)	1.24	817.03	0.15
New Hampshire	17	46 (0)	28.51	1075.02	2.65
North of Boston	49	104 (0)	34.06	1297.90	2.62
South of Boston	12	39 (0)	5.38	216.98	2.48
South of Cape Cod	8	35 (17)	29.58	1586.30	1.86
East of Cape Cod	14	63 (0)	25.39	1922.97	1.32
Offshore	3	30 (0)	7.61	150.23	5.07
Closure Strata					
Northeast Closure	0	0 (0)	0.00	0.00	0.00
Great S. Channel Closure	0	0 (0)	0.00	1.91	0.00
Subtotal	105	332 (17)	131.77	7171.61	1.84
Fall (Sep-Dec)	**Observed Trips**	**Observed Hauls (Limited Hauls)**	**Observed Metric Tons**	**Prorated Metric Tons**	**Coverage (Metric Tons) %**
Port Group-Area Strata					
Northern Maine	0	0 (0)	0.00	23.71	0.00
Southern Maine	4	27 (0)	18.84	239.57	7.86
New Hampshire	10	23 (6)	11.32	210.65	5.37
North of Boston	27	61 (28)	15.24	676.60	2.25
South of Boston	22	61 (11)	17.65	246.91	7.15
South of Cape Cod	19	108 (52)	24.35	1358.28	1.79
East of Cape Cod	32	132 (43)	47.73	1096.30	4.35
Offshore	3	16 (0)	11.98	137.87	8.69
Closure Strata					
Northeast Closure	0	0 (0)	0.00	0.00	0.00
Offshore Closure	1	8 (0)	7.72	95.73	8.06
Midcoast Closure	56	200 (85)	59.66	1657.58	3.60
Mass Bay Closure	11	20 (6)	4.60	182.40	2.52
South Cape Closure	1	1 (0)	0.00	207.85	0.00
Subtotal	186	657 (231)	219.09	6133.45	3.57
2009 Total	**544**	**1944 (542)**	**655.68**	**17206.78**	**3.81**

Table 2. Using both limited and complete observed trips, 2009 Mid-Atlantic state gillnet totals for observed trips, observed hauls, limited hauls, observed metric tons of fish landed, prorated total metric tons of fish landed, and percent observer coverage, by season and state. Effort inside bays and sounds was not included in this table (e.g., Delaware Bay, Chesapeake Bay, Albemarle Sound, and Pamlico Sound).

Winter (Jan-May)	Observed Trips	Observed Hauls (Limited Hauls)	Observed Metric Tons	Prorated Metric Tons	Coverage (Metric Tons) %
Massachusetts	0	0 (0)	0	1.45	0.00%
Rhode Island	0	0 (0)	0	5.91	0.00%
Connecticut	1	6 (0)	2.79	4.85	57.53%
New York	4	9 (9)	1.39	57.82	2.40%
New Jersey	36	143 (102)	35.06	807.57	4.34%
Delaware	0	0 (0)	0	0	-
Maryland	11	50 (10)	11.65	289.53	4.02%
North Carolina	60	292 (283)	48.1	2769.82	1.74%
Virginia	35	153 (138)	41.76	901.9	4.63%
Subtotal	147	653 (542)	140.75	4838.85	2.91%
Summer (June-Aug)	**Observed Trips**	**Observed Hauls (Limited Hauls)**	**Observed Metric Tons**	**Prorated Metric Tons**	**Coverage (Metric Tons) %**
Rhode Island	0	0 (0)	0	0.05	
New York	3	17 (4)	1.09	73.48	1.48%
New Jersey	22	75 (65)	25.83	668.76	3.86%
Delaware	0	0 (0)	0	0	-
Maryland	0	0 (0)	0	66.19	0.00%
North Carolina	8	57 (57)	1.42	91.77	1.55%
Virginia	2	2 (2)	0.03	186.42	0.02%
Subtotal	35	151 (128)	28.37	1086.67	2.61%
Fall (Sept-Dec)	**Observed Trips**	**Observed Hauls (Limited Hauls)**	**Observed Metric Tons**	**Prorated Metric Tons**	**Coverage (Metric Tons) %**
New York	2	11 (11)	0.16	56.98	0.28%
New Jersey	45	207 (141)	50.04	864.19	5.79%
Delaware	0	0 (0)	0	4.27	0.00%
Maryland	3	13 (8)	3.48	152.11	2.29%
North Carolina	32	230 (224)	10.29	827.12	1.24%
Virginia	23	111 (111)	19.45	873.29	2.23%
Subtotal	105	572 (495)	83.42	2777.96	3.00%
Annual Totals	287	1376 (1165)	252.54	8703.48	2.90%

Table 3. 2009 common dolphin bycatch estimate in the NESG.

2009 Winter (Jan-May) Port Group-Area Strata	Observed Takes	Bycatch Rate (Take/Ton)	Estimated Takes	C.V. (%)	95% C.I.
Northern Maine					
Southern Maine					
New Hampshire					
North of Boston	1*	0.040♦	12.50	106%	1-39
South of Boston					
South of Cape Cod	1§	0.022	29.31	101%	1-87
East of Cape Cod					
Offshore					
Closure Strata					
Offshore Closure					
Cashes Ledge Closure					
Midcoast Closure					
Mass Bay Closure					
Cape Cod Bay Closure					
South Cape Closure					
Great S. Channel Closure					
Hanging Ratio Study					
South of Cape Cod Study	1		1		
Subtotal	3		42.81	77%	3-105
Summer (Jun-Aug) Port Group-Area Strata	**Observed Takes**	**Bycatch Rate (Take/Ton)**	**Estimated Takes**	**C.V. (%)**	**95% C.I.**
Northern Maine					
Southern Maine					
New Hampshire					
North of Boston					
South of Boston					
South of Cape Cod					
East of Cape Cod					
Offshore					
Closure Strata					
Northeast Closure					
Great S. Channel Closure					
Subtotal	0		0		

Table 3, continued. 2009 common dolphin bycatch estimate in the NESG.

Fall (Sep-Dec)	Observed Takes	Bycatch Rate (Take/Ton)	Estimated Takes	C.V. (%)	95% C.I.
Port Group-Area Strata					
Northern Maine					
Southern Maine					
New Hampshire					
North of Boston					
South of Boston					
South of Cape Cod					
East of Cape Cod					
Offshore					
Closure Strata					
Northeast Closure					
Offshore Closure					
Midcoast Closure					
Mass Bay Closure					
South Cape Closure					
Subtotal	0		0		
2009 Total	**3**		**42.81**	**77%**	**3-105**

* Observed take from haul equipped with pingers.

§ Observed take from haul not equipped with pingers.

♦ A weighted bycatch rate (observed hauls with and without pingers were used to calculate a weighted bycatch rate)

Table 4. 2009 harbor porpoise bycatch estimate in the NESG.

2009 Winter (Jan-May)	Observed Takes	Bycatch Rate (Take/Ton)	Estimated Takes	C.V. (%)	95% C.I.
Port Group-Area Strata					
Northern Maine					
Southern Maine					
New Hampshire					
North of Boston	11	0.296♦	92.53	32%	35-150
South of Boston					
South of Cape Cod	4§	0.088	117.22	57%	4-247
East of Cape Cod	6§	0.117♦	80.21	51%	6-160
Offshore					
Closure Strata					
Offshore Closure					
Cashes Ledge Closure					
Midcoast Closure	2*	0.127♦	27.55	107%	2-85
Mass Bay Closure	2*	0.154♦	26.81	72%	2-65
Cape Cod Bay Closure					
South Cape Closure					
Great S. Channel Closure					
Hanging Ratio Study					
South of Cape Cod Study	12		12		
Subtotal	37		356.32	26%	167-522

Summer (Jun-Aug)	Observed Takes	Bycatch Rate (Take/Ton)	Estimated Takes	C.V. (%)	95% C.I.
Port Group-Area Strata					
Northern Maine					
Southern Maine					
New Hampshire	1§	0.035	37.63	100%	1-111
North of Boston					
South of Boston					
South of Cape Cod					
East of Cape Cod					
Offshore					
Closure Strata					
Northeast Closure					
Great S. Channel Closure					
Subtotal	1		37.63	100%	1-111

Table 4, continued. 2009 harbor porpoise bycatch estimate in the NESG.

Fall (Sep-Dec)	Observed Takes	Bycatch Rate (Take/Ton)	Estimated Takes	C.V. (%)	95% C.I.
Port Group-Area Strata					
Northern Maine					
Southern Maine					
New Hampshire					
North of Boston					
South of Boston					
South of Cape Cod					
East of Cape Cod	1§	0.021	23.02		
Offshore					
Closure Strata					
Northeast Closure					
Offshore Closure					
Midcoast Closure	5*	0.084♦	139.24	59%	5-300
Mass Bay Closure	1*	0.188♦	34.29	109%	1-108
South Cape Closure					
Subtotal	7		196.55	46%	19-374
2009 Total	**45**		**590.50**	**23%**	**322-835**

* Observed take from haul equipped with pingers.

§ Observed take from haul not equipped with pingers.

♦ A weighted bycatch rate (observed hauls with and without pingers were used to calculate a weighted bycatch rate)

Table 5. 2009 gray seal bycatch estimate in the NESG.

2009 Winter (Jan-May)	Observed Takes	Bycatch Rate (Take/Ton)	Estimated Takes	C.V. (%)	95% C.I.
Port Group-Area Strata					
Northern Maine					
Southern Maine					
New Hampshire					
North of Boston					
South of Boston					
South of Cape Cod	9§	0.199	265.08	43%	40-490
East of Cape Cod	12§	0.234♦	160.42	45%	18-301
Offshore					
Closure Strata					
Offshore Closure					
Cashes Ledge Closure					
Midcoast Closure					
Mass Bay Closure	1*	0.077♦	13.40	107%	1-42
Cape Cod Bay Closure					
South Cape Closure	11*	0.338♦	214.35	60%	11-467
Great S. Channel Closure					
Hanging Ratio Study					
South of Cape Cod Study	6		6		
Subtotal	39		659.25	28%	290-1016

Summer (Jun-Aug)	Observed Takes	Bycatch Rate (Take/Ton)	Estimated Takes	C.V. (%)	95% C.I.
Port Group-Area Strata					
Northern Maine					
Southern Maine					
New Hampshire					
North of Boston					
South of Boston					
South of Cape Cod					
East of Cape Cod	2§	0.079	151.91	78%	2-384
Offshore					
Closure Strata					
Northeast Closure					
Great S. Channel Closure					
Subtotal	2		151.91	78%	2-384

Table 5, continued. 2009 gray seal bycatch estimate in the NESG.

Fall (Sep-Dec)	Observed Takes	Bycatch Rate (Take/Ton)	Estimated Takes	C.V. (%)	95% C.I.
Port Group-Area Strata					
Northern Maine					
Southern Maine					
New Hampshire					
North of Boston					
South of Boston					
South of Cape Cod					
East of Cape Cod	11[§]	0.230	252.15	63%	11-561
Offshore					
Closure Strata					
Northeast Closure					
Offshore Closure					
Midcoast Closure					
Mass Bay Closure					
South Cape Closure					
Subtotal	11		252.15	63%	11-561
2009 Total	**52**		**1,063.31**	**26%**	**515-1599**

***** Observed take from haul equipped with pingers.

[§] Observed take from haul not equipped with pingers.

♦ A weighted bycatch rate (observed hauls with and without pingers were used to calculate a weighted bycatch rate)

Table 6. 2009 harbor seal bycatch estimate in the NESG.

2009 Winter (Jan-May)	Observed Takes	Bycatch Rate (Take/Ton)	Estimated Takes	C.V. (%)	95% C.I.
Port Group-Area Strata					
Northern Maine					
Southern Maine					
New Hampshire					
North of Boston	2*	0.080♦	25.01	78%	2-63
South of Boston					
South of Cape Cod	4§	0.088	117.22	57%	4-248
East of Cape Cod	1§	0.019	13.03	106%	1-40
Offshore					
Closure Strata					
Offshore Closure					
Cashes Ledge Closure					
Midcoast Closure					
Mass Bay Closure					
Cape Cod Bay Closure					
South Cape Closure	6§	0.185♦	117.32	65%	6-267
Great S. Channel Closure					
Hanging Ratio Study					
South of Cape Cod Study	0		0		
Subtotal	13		272.58	38%	69-476

Summer (Jun-Aug)	Observed Takes	Bycatch Rate (Take/Ton)	Estimated Takes	C.V. (%)	95% C.I.
Port Group-Area Strata					
Northern Maine					
Southern Maine					
New Hampshire	3§	0.105	112.88	75%	3-279
North of Boston	2§	0.059	76.58	71%	2-183
South of Boston					
South of Cape Cod					
East of Cape Cod					
Offshore					
Closure Strata					
Northeast Closure					
Great S. Channel Closure					
Subtotal	5		189.46	54%	5-390

Table 6, continued. 2009 harbor seal bycatch estimate in the NESG.

Fall (Sep-Dec)	Observed Takes	Bycatch Rate (Take/Ton)	Estimated Takes	C.V. (%)	95% C.I.
Port Group-Area Strata					
Northern Maine					
Southern Maine					
New Hampshire	1§	0.088	18.54	94%	1-53
North of Boston					
South of Boston					
South of Cape Cod					
East of Cape Cod	1§	0.021	23.02	95%	1-66
Offshore					
Closure Strata					
Northeast Closure					
Offshore Closure	1§	0.130	12.44		
Midcoast Closure					
Mass Bay Closure					
South Cape Closure					
Subtotal	3		54.00	52%	3-109
2009 Total	**21**		**516.04**	**28%**	**232-800**

* Observed take from haul equipped with pingers.

§ Observed take from haul not equipped with pingers.

♦ A weighted bycatch rate (observed hauls with and without pingers were used to calculate a weighted bycatch rate)

Table 7. 2009 harp seal bycatch estimate in the NESG.

2009 Winter (Jan-May)	Observed Takes	Bycatch Rate (Take/Ton)	Estimated Takes	C.V. (%)	95% C.I.
Port Group-Area Strata					
Northern Maine					
Southern Maine					
New Hampshire					
North of Boston	2§	0.051♦	15.94	71%	2-38
South of Boston					
South of Cape Cod	6§	0.133	177.16	54%	6-363
East of Cape Cod	11§	0.214	146.71	31%	58-235
Offshore					
Closure Strata					
Offshore Closure					
Cashes Ledge Closure					
Midcoast Closure	1*	0.063♦	13.67	134%	1-50
Mass Bay Closure	1*	0.077♦	13.40	105%	1-41
Cape Cod Bay Closure					
South Cape Closure	2*	0.062♦	39.32	61%	2-87
Great S. Channel Closure					
Hanging Ratio Study					
South of Cape Cod Study	9		9		
Subtotal	32		415.20	27%	189-623
Summer (Jun-Aug)	**Observed Takes**	**Bycatch Rate (Take/Ton)**	**Estimated Takes**	**C.V. (%)**	**95% C.I.**
Port Group-Area Strata					
Northern Maine					
Southern Maine					
New Hampshire					
North of Boston					
South of Boston					
South of Cape Cod					
East of Cape Cod					
Offshore					
Closure Strata					
Northeast Closure					
Great S. Channel Closure					
Subtotal	0		0.00		

Table 7, continued. 2009 harp seal bycatch estimate in the NESG.

Fall (Sep-Dec)	Observed Takes	Bycatch Rate (Take/Ton)	Estimated Takes	C.V. (%)	95% C.I.
Port Group-Area Strata					
Northern Maine					
Southern Maine					
New Hampshire					
North of Boston					
South of Boston					
South of Cape Cod					
East of Cape Cod					
Offshore					
Closure Strata					
Northeast Closure					
Offshore Closure					
Midcoast Closure					
Mass Bay Closure					
South Cape Closure					
Subtotal	0		0.00		
2009 Total	**32**		**415.20**	**27%**	**189-623**

* Observed take from haul equipped with pingers.

§ Observed take from haul not equipped with pingers.

♦ A weighted bycatch rate (observed hauls with and without pingers were used to calculate a weighted bycatch rate)

Table 8. For 2009 totals for species/time/area specific Mid-Atlantic strata, totals for observed trips, observed hauls, observed metric tons of fish landed, prorated total metric tons of fish landed, and percent observer coverage by season.

Species Applicability	2009 Time Period	State(s)	Mesh Size	Observed Trips	Observed Hauls (Limited Hauls)	Observed Metric Tons	Prorated Metric Tons	Coverage (Metric Tons) %
Harbor Porpoise	Jan-April	NJ	Large	17	61 (36)	22.07	500.30	4.41%
Harbor Porpoise	Feb-Mar	NC	All	21	109 (106)	18.71	1215.96	1.54%
Harp and Harbor Seals	Jan-April	NJ	All	25	97 (71)	22.45	525.86	4.27%

Table 9. 2007 Mid-Atlantic harbor porpoise, harbor seal, and harp seal bycatch estimates in the MAG.

Species	2009 Months/ Season	Area/State	Mesh	Observed Takes	Bycatch Rate (Take/Ton)	Estimated Takes	C.V. (%)	95% C.I.
Harbor Porpoise	Winter (Jan-Apr)	Waters off NJ	Large	6	0.272	136.08	54%	6-279
	Feb-Mar	NC	All	1	0.053	64.45	133%	1-233
	Annual total	Mid-Atlantic total	All	7		200.53	55%	7-417
Harbor Seal	Winter (Jan-Apr)	Waters off NJ	All	2	0.089	46.80	68%	2-109
Harp Seal	Winter (Jan-Apr)	Waters off NJ	All	3	0.134	70.47	69%	3-166

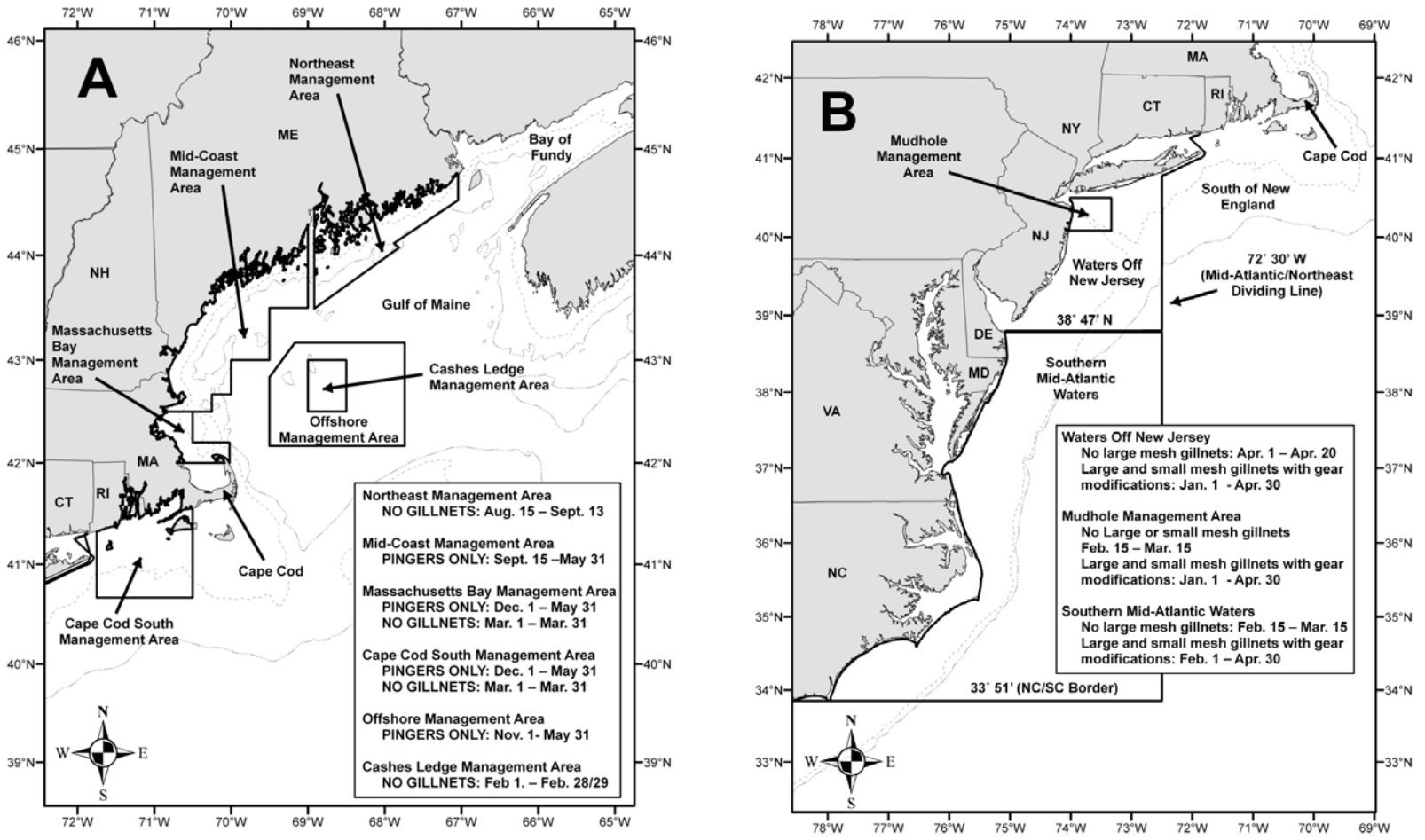

Figure 1. Gillnet fishery and harbor porpoise management areas for (A) New England region and (B) Mid-Atlantic region. Dashed light gray lines depict 50 and 100 m depth contours (Orphanides 2009).

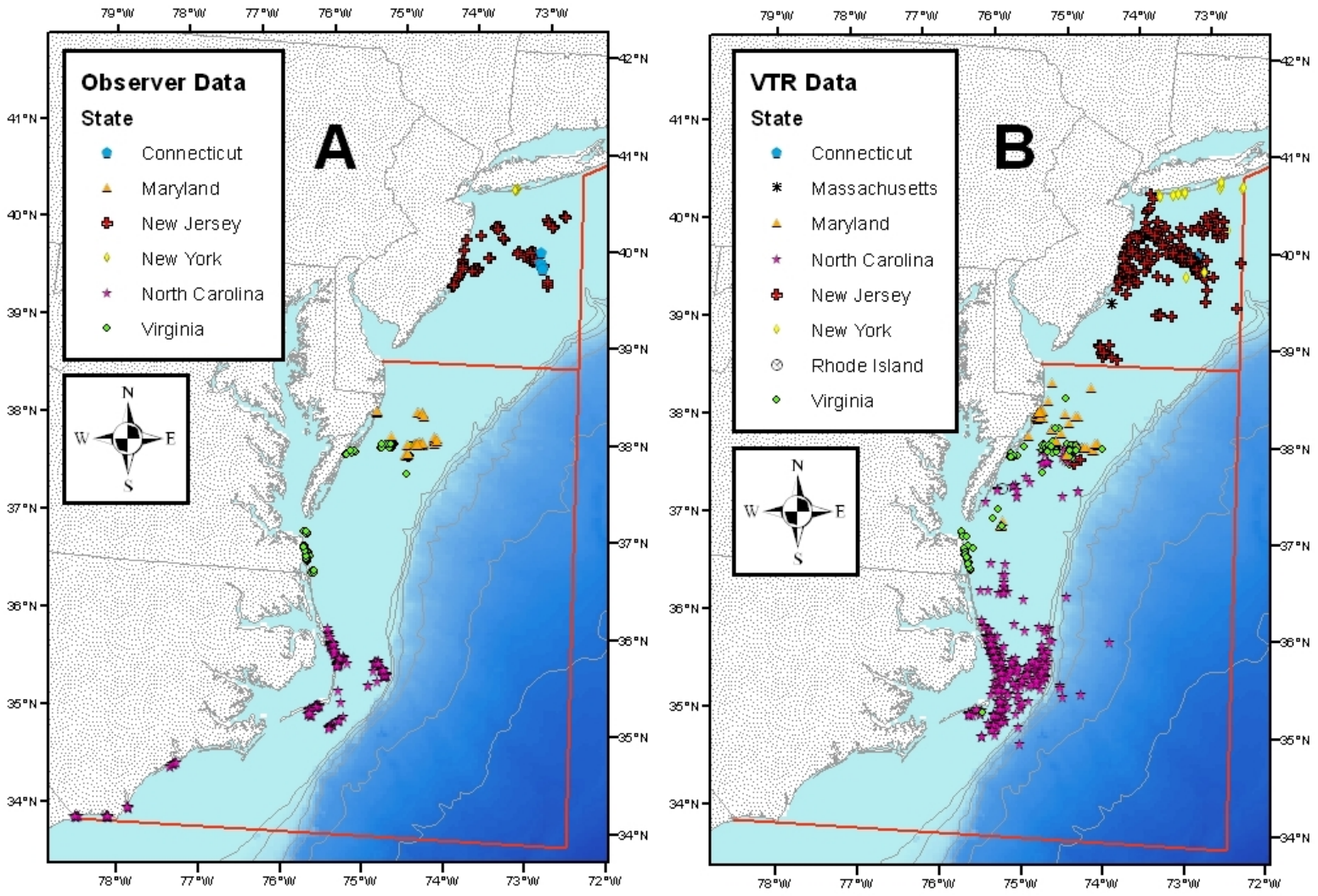

Figure 2. January-April 2009 Mid-Atlantic NEFOP observed hauls (A) and VTR trips (B) by state. Red line indicates Mid-Atlantic border at 72º30'W longitude, the southern extent of the Waters off New Jersey, and the NC/SC border. Gray lines indicate ocean depth contours at 200, 500, 1000, 2000, 3000, and 4000 m.

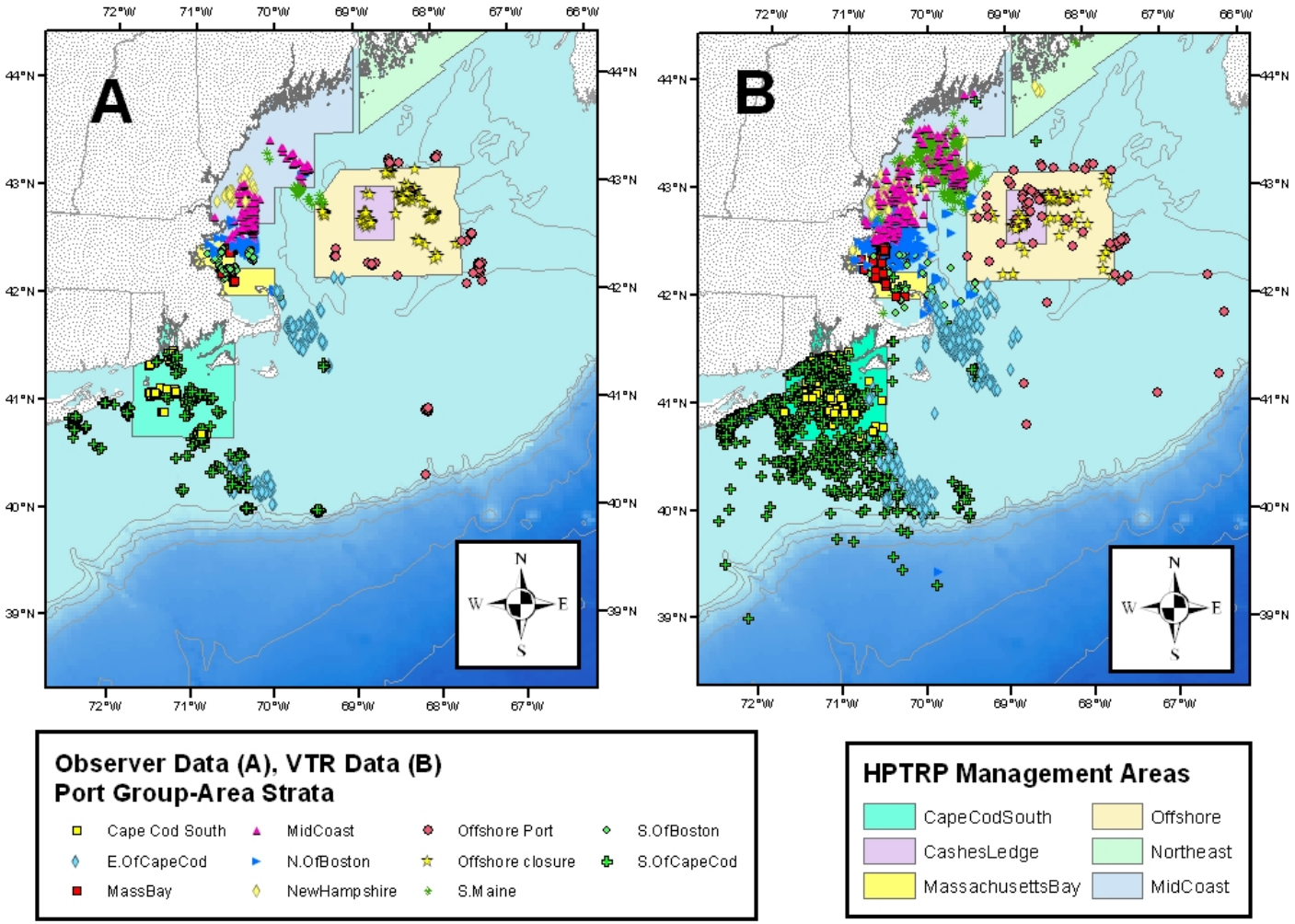

Figure 3. 2009 New England NEFOP observed hauls (A) and VTR trips (B) by port group-area strata. Gray lines indicate ocean depth contours at 200, 500, 1000, 2000, 3000, and 4000 m.

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